

A NEW SPECIES OF SCINCID LIZARD (LYGOSOMINAE: *LEIOLOPISMA*) FROM THE HIGHLANDS OF TASMANIA

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ABSTRACT: A new species of lygosomine scincid lizard, *Leiolopisma orocryptum*, is described. The new species is known from at least two populations in southwest Tasmania. The type series was collected from a distinctive subalpine habitat characterized by dense heathy vegetation. *L. orocryptum* is most similar, and probably most closely related to three other Tasmanian species of *Leiolopisma*, *L. pretiosum*, *L. microlepidotum* and *L. metallicum*, and problems of differentiating the four species are discussed.

The island state of Tasmania forms the most southerly projection of the Australian continent and its cool, cloudy and wet climate supports a relatively impoverished reptilian fauna. Fifteen species of lizards and three species of snakes are recognised from Tasmania and its adjacent small islands, including the islands of Bass Strait (Rawlinson 1974a, 1974b, 1975). This diversity compares with 32 lizards, nine snakes and a turtle known from the adjacent temperate mainland (southern Victoria) (Rawlinson 1974a, Hutchinson & Robertson ms.).

The Tasmanian fauna is, however, more than a diminished southern extension of the southeast mainland fauna. Five of the State's fourteen species of skink are endemic, all members of the lygosomine genus *Leiolopisma* (*sensu* Greer 1982, Hutchinson *et al.* in press). Two of these, *L. ocellatum* (Gray 1845) and *L. pretiosum* (O'Shaughnessy 1874) are widespread and have long been recognized as distinct. The other three are confined to more specialized habitats. *L. palfreymani* (*Pseudemoia palfreymani auct.*) was described by Rawlinson (1974b) and is confined to the islet of Pedra Branca, the southernmost island on the Australian continental shelf (43°52'S, 146°59'E). *L. greeni* was described the following year (Rawlinson 1975). It is an alpine specialist, confined to rocky areas above the treeline in the northern half of Tasmania. The third species, *L. microlepidotum* (O'Shaughnessy 1874), has only recently been resurrected from synonymy with *L. pretiosum* (Hutchinson *et al.* in press) and is another high mountain species, occupying similar habitats to *L. greeni* in southern and southwestern Tasmania.

During fieldwork in southwestern Tasmania in January and February 1987, we collected a series of unusual *Leiolopisma* on the upper slopes of Mt Eliza, just east of the enlarged Lake Pedder. They were clearly distinct from the *L. microlepidotum* with which they were sympatric. Shortly afterwards, three more specimens of the same taxon were collected 70 km northwest at Algonkian Mountain where they were sympatric with *L. metallicum*. The two populations

are identical in colour and scalation and possess a combination of character states not known to occur in any of the described Tasmanian species. It is evident that the two populations represent a new species which is described below, and compared with its relatives in the Tasmanian radiation of *Leiolopisma*.

Leiolopisma orocryptum sp. nov.

Figs 1-3

HOLOTYPE: Tasmanian Museum (TM) C685. Adult male.

TYPE LOCALITY AND COLLECTORS: High Camp Memorial Hut on the Mt Anne trail, upper slopes of Mt Eliza (42°58'S, 146°24'E), 970 m elevation, Tasmania. M. N. Hutchinson and T. D. Schwaner, 31/i/87.

DIAGNOSIS: *L. orocryptum* is a medium-sized (adult SVL 48-62 mm) member of the Australian *Leiolopisma* (*sensu* Greer 1982) radiation with the following unique combination of character states: frontoparietals fused; supranasals and postnasals absent; 28-32 midbody scale rows (usually 28 or 30), 59-66 (mean 62) paravertebral scales; long limbs (hind limbs 35%-46% of SVL), viviparous (litter 3 or 4); colour pattern including a black vertebral stripe and white mid-lateral stripe and with dark dorsal flecks tending to align longitudinally.

ETYMOLOGY: The specific name comes from the Greek *oros* (mountain) and *kruptos* (hidden), referring to the fact that the species has remained hitherto undetected in its montane habitat.

DESCRIPTION OF HOLOTYPE: Scale nomenclature and positions of measurements follow Greer (1982). Mid-body scales in 30 rows. Dorsal scales with three shallow grooves, lateral scales weakly grooved. Paravertebral scales 62. Mid ventral scales (mental to preanal inclusive) 73. Preanal scales ten, the median four slightly enlarged. Palmar tubercles rounded. Subdigital lamellae smooth, undivided, 21 under the fourth toe. Supranasal and postnasal scales absent. Rostral and



Fig. 1—Holotype specimen of *Leiolopisma orocryptum* n.sp. (TM C685), Mt Eliza southwest Tasmania.

frontonasal in narrow contact. Prefrontals separated, frontal contacts frontonasal. Supraoculars four, the second the largest; first and second in contact with frontal. Frontoparietals fused. Interparietal distinct. Parietals large, contact behind the interparietal. Each parietal bordered posterolaterally by the upper secondary temporal and an enlarged nuchal. Supraciliaries seven. Loreals two, subequal in size. Preoculars two, the lower twice as deep as the upper. Presubocular single (a second small presubocular on the left side). Upper ciliaries nine, the 6th, 7th and 8th enlarged. Lower ciliaries eleven. A moderate, transparent, palpebral disc in the lower eyelid. Upper labials seven, the fifth subocular. Second upper labial large, contacting the lower preocular. One primary and two secondary temporals. Lower labials seven (six on the right side due to fusion of the first lower labial with the mental). Postmental contacts first and second lower labials. Ear opening obvious, vertically oval, without well-developed lobules.

Snout-vent length (SVL) 57 mm. Length of tail (original) 87 mm (153% of SVL). Length of forelimb 16 mm (28% of SVL). Length of hind limb 23 mm (40% of SVL). Head width 8.5 mm (15% of SVL). Length of eye 2.5 mm. Length of palpebral disc 1.1 mm (44% of eye length). Maximum diameter of ear opening 1.4 mm (56% of eye length).

Dorsal surface of head, body, tail and limbs light brown. A ragged black vertebral stripe runs from the nuchal scales, along the back and along the tail where it becomes broken into a series of black flecks. Two weaker black lines flank the vertebral stripe on each side, all five dorsal lines being formed by dark pigment disposed in the corners of the six median dorsal scale rows. The four median scale rows (rows 1 and

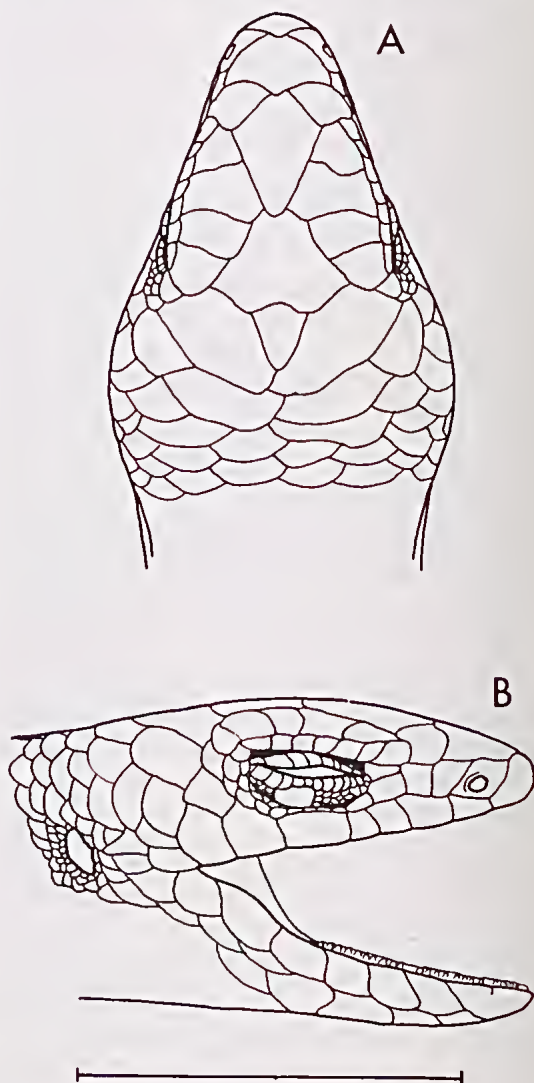


Fig. 2—Head shields of *Leiolopisma orocryptum* n.sp., holotype specimen (TM C685). A, dorsal view; B, right lateral view.

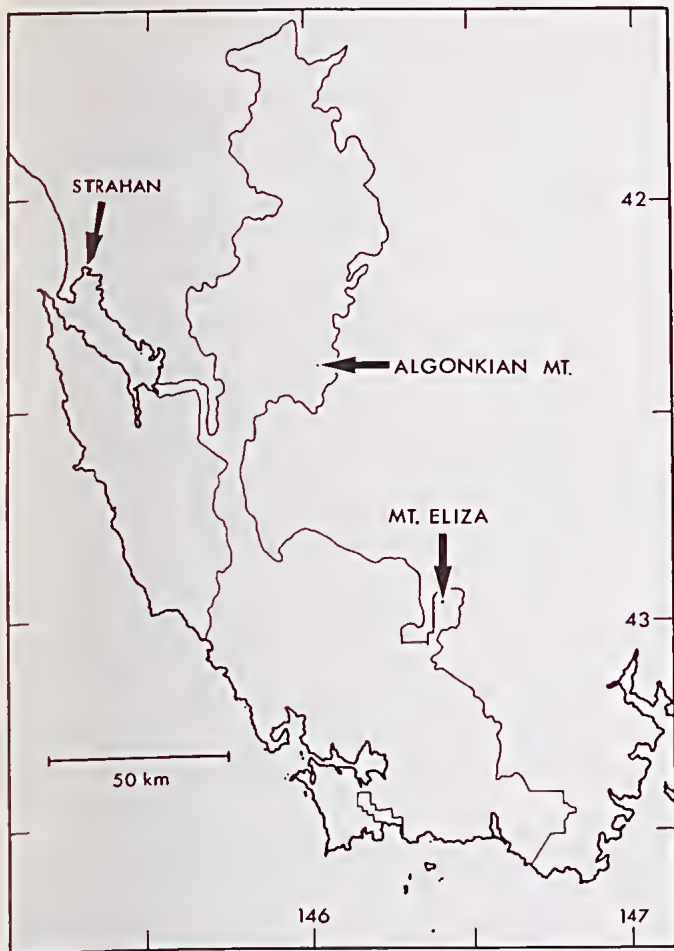


Fig. 3—Map of southwest Tasmania showing collecting localities for *Leiolopisma orocryptum* n.sp.; Mt Eliza is the type locality. The outline indicates the boundaries of the Western Tasmanian World Heritage wilderness area.

2 on each side) also have scattered darker smudges and flecks. Dorsolateral area unmarked pale brown, forming a weakly-defined, dorsolateral, pale stripe. A broad, dark, upper, lateral stripe runs over scale rows 4-7. The stripe runs forward broadly over the temporals to the orbit and narrows anteriorly to form a dark canthal line ending at the naris. Posteriorly it breaks up on the base of the tail into a narrow series of dark flecks. A prominent grey-white, mid-lateral stripe borders the upper lateral stripe ventrally, and is, in turn, margined below by a zone of blackish flecks. Dorsal surfaces of limbs brown with irregular black spots. Palmar and plantar surfaces dark grey. Subdigital lamellae black. Venter, pale whitish grey, immaculate apart from some greyish smudges on the chin and gular scales. Colour in life similar to that in preservative.

PARATYPES: Twenty five specimens (TM C657-679, C684, C776) same locality and collection data as the holotype. Eight specimens are regarded as mature males, nine as mature females, four as immature males and four as immature females.

DESCRIPTION: As for holotype, with the following additions and exceptions. Midbody scales in 28-32 rows (mean 29.3, mode 30). Dorsals weakly-grooved.

Paravertebral scales 59-66 (mean 61.9). Subdigital lamellae under fourth toe 20-24 (mean 22.2). Prefrontals separated (24 specimens) or in point contact (1 specimen). Supraciliaries 7/7 (11 specimens), 6/6 (5 specimens) or 6/7 (9 specimens). Presuboculars 1 (23 specimens) or 2 (2 specimens). Second upper labial enlarged, in at least point contact with lower preocular (19 specimens) or fails to contact lower preocular (6 specimens). Lower labials 7/7.

Snout-vent length of adult males (with enlarged testes) 47-62 mm (mean 54.9); of adult females (as large as or larger than the smallest with young) 52-62 mm (mean 56.7). Length of original tail (as % SVL) 122-162 (mean 144). Length of hind limb (as % SVL) 34.8-46.0 (mean 40.4). Head width (as % SVL) adult males 13.4-15.3 (mean 14.3); adult females 11.3-13.3 (mean 12.3).

In preservative, dorsum light to dark brown. A black vertebral stripe present in all specimens, although broken into a series of irregular black spots in some, running from just behind the nuchal scales and onto the tail where it continues as a series of dark smudges. Four median, dorsal scale rows with variable black markings. In most, these markings are aligned longitudinally to form an interrupted dark laterodorsal line on each side. Additional mid-dorsal

TABLE 1
SUMMARY OF DIFFERENCES AMONG FOUR TASMANIAN SPECIES OF *Leiolopisma**

Character	<i>L. metallicum</i>	<i>L. microlepidotum</i>	<i>L. orocryptum</i>	<i>L. pretiosum</i>
Midbody scale rows (modes)	22-29 (24, 26)	30-44 (34, 36)**	28-32 (28, 30)	32-38 (34, 36)
Paravertebral scales (mean, n)	52-63 (57.4, 106)	61-81 (71.2, 58)	69-66 (61.9, 26)	58-67 (61.8, 79)
Adult SVL (mm) (mean, n)	47-66 (53.0, 89)	51-69 (60.0, 61)	48-62 (55.9, 18)	43-57 (50.3, 53)
Male hind limb length (% SVL) (mean, n)	31-40 (37, 41)	35-45 (40, 39)	40-46 (43.9)	37-43 (40, 15)
Presuboculars	1	Usually 2	1	1
Paravertebral scales enlarged transversely	Yes	No	No	No
Prominent white midlateral stripe	Variable	Usually absent	Present	Present
No. of scale rows contacted by black lateral stripe	3	4 or 5	4	4
Dorsal markings include whitish flecks	Sometimes	Never	Never	Usually
Red venter in adults	Usually	Never	Usually absent (present in 1 specimen)	Frequently

* Excludes island populations.

** Based on the main south-central Tasmanian populations. Far southern specimens have a mode of 32, while at Mt Wellington (southeast isolate) the modes are 38 and 40 (Hutchinson *et al.* in press).

dark flecking is also present in most adult specimens. Dark markings much reduced and almost absent in young individuals. Dorsolateral scales (row 3 on each side) usually immaculate, and often paler golden brown, forming a dorsolateral light stripe. Broad, black, upper, lateral stripe running from the temporal region above the axilla to the base of the tail, where it narrows before fading about midway along the tail. This stripe usually immaculate except for scattered pale brown or white flecks near its ventral margin. A broad, ragged-edged, grey-white, mid-lateral stripe runs from the posterior labial scales to the insertion of the hind limbs. This stripe margined below by a zone of dark grey or black flecks. Top of head with variable dark flecks. Limbs brown with black and pale brown speckling. Venter pale whitish grey, immaculate except for some grey flecks on the neck and chin scales in a few specimens.

Coloration in life as above. The only exception was a large female (TM C684) which had bright red ventral colouring running from the chest to the tail tip. No other specimens showed any red ventral pigment.

CRANIAL OSTEOLOGY: Skulls of a single adult male and female were prepared and the following taxonomically-important features noted. Premaxillary teeth 11 (5 left, 6 right); palatal rami of the palatines overlapping medially and with prong-like posteromedial projections; pterygoids widely separated without

posteromedial palatal projections; pterygoid teeth absent; ectopterygoids without anteriorly-directed process towards palatines; frontals fused; prefrontals with tapered anterior projections which almost reach the nasal openings, nearly excluding contact between the maxillae and frontal; upper temporal fenestrae present, small.

HABITAT AT TYPE LOCALITY: Low (2-3 m) *Eucalyptus coccifera* woodland with dense, healthy understorey including *Richea*, *Olearia* and *Telopea*. This woodland is limited to a zone on the western face of Mt Eliza between approximately 920 m and 1000 m elevation. Below it is a uniform buttongrass (*Gymnoschoenus*) dominated slope and above is the alpine boulder-scree habitat which continues up to the Eliza plateau. The type series was collected between about 11 am and 1 pm on a sunny day. Lizards were using the bases of branches of *Eucalyptus* as basking sites and were also observed clambering through the outer foliage of understorey shrubs. Although rocky outcrops and boulders were thickly scattered through this woodland, the lizards appeared to prefer the dense vegetation to the rock surfaces as sites for their activity. This species was not observed above or below the limits of this dense vegetation.

SYMPATRIC SPECIES: *Leiolopisma microlepidotum* also occurs at the type locality where it is completely restricted to emergent rock faces and boulders. *L. oro-*

cryptum and *L. microlepidotum* were collected within a few metres of each other. *L. microlepidotum* becomes more common towards the upper limits of the woodland where this habitat gives way to a steep dolerite boulder scree which marks the start of the alpine zone, and is the only species of reptile in this habitat. Just below the lower limit of the woodland habitat *Leiopisma metallicum* is moderately common, and a single elapid snake, *Notechis ater*, was also collected on the lower slopes.

REFERRED SPECIMENS: Three further specimens of *L. orocryptum* (TM C794-6) were collected at the summit of Algonkian Mountain (42° 14'S, 146° 03'E), 70 km NNW of Mt Eliza. The three, a pregnant female and two immature specimens, fall within the scalation parameters of the type series, and have identical colour patterns. They were collected with two specimens of *L. metallicum*. Their collector, Dr S. Smith, Tasmanian National Parks and Wildlife Service, has informed us that the five lizards were collected just below the summit of the mountain, at about 1020 m elevation. They were mostly collected about 1 m above the ground in flowering bushes of *Leptospermum rupestre*, surrounded by low heath vegetation and burnt open areas of pineapple grass (*Astelia alpina*). Thus arboreal activity and preference for alpine-heathy vegetation appear to be consistent features of the two known populations of *L. orocryptum*.

Both populations are from areas presently enclosed within national parks which are part of the Western Tasmanian World Heritage area (Fig. 3). This is a wilderness area which is very poorly surveyed biologically so that it is almost inevitable that further populations of *L. orocryptum* will be found there. The lack of any access to most of this area helps to explain the long delay in discovering this species as does its apparent preference for some of the most difficult terrain in the region — high-altitude, dense, prickly scrub.

One further specimen is probably referable to this species. Museum of Victoria (MV) D38006 was collected from Strahan, almost at sea level on the west coast (Rawlinson pers. comm.). Its size (59 mm SVL), body scalation (32 midbody, scale rows, 59 paravertebrals), bold white midlateral stripe and forested habitat all suggest *L. orocryptum*. Unusual features for this specimen are the low elevation from which it was collected and its completely-unmarked, golden-brown dorsum. The plain dorsal colouring is however seen in some young specimens from Mt Eliza, so that this variation is not unknown in this species. By contrast, the two other Tasmanian species which show overlap with this specimen in midbody scale counts, (*L. microlepidotum* and *L. pretiosum*), do not approach it as closely in colour pattern (neither species), paravertebral counts (*L. microlepidotum*) or size (*L. pretiosum*) as does *L. orocryptum*. Further specimens of this population are highly desirable to confirm both the identification and the habitat preference, as it raises the possibility that *L. orocryptum* is widely distributed, in suitable habitats, through much of western Tasmania.

REPRODUCTION: Six of the type series were pregnant females containing 3 or 4 (mean 3.12, mode 3) embryos, all of which were well grown, but still unscaled and clearly not close to parturition. Three other females showed no signs of embryo development, but were at least as large as the smallest female (SVL 52 mm) with young. These latter three appear to have not bred this year. The adult males had moderately to greatly-enlarged testes, indicating the onset of reproductive activity. Apparently *L. orocryptum* is similar to other Australian viviparous *Leiopisma* in having the male and female gonadal cycles out of phase (Rawlinson 1974a). Males presumably inseminate females in late summer-early autumn, after parturition. Females would then store the sperm over winter and ovulation and fertilization would occur during the following spring.

The presence of non-breeding females in this population is concordant with earlier observations on *L. microlepidotum* and *L. greeni* (Greer 1982, Hutchinson *et al.* in press). Both species are restricted to alpine areas in Tasmania and have populations which include females which do not breed every year. For example, in series of *L. microlepidotum* we collected at Mt Eliza and Mt Hartz, 60% and 67% respectively of the females were pregnant, while populations of *L. greeni* from Mt Rufus and Pine Lake had 54% and 60% of the females pregnant. No work has yet been done to establish why females of these species would skip a breeding season, but we suspect that the climate plays an important role. Summer in the Tasmanian highlands is short and cool by Australian standards and daily weather conditions vary greatly, including the possibility of snow in every month of the year. Such a climate would be expected to result in a reduced, and often interrupted, active season for montane skinks, so that not all females may be able to forage sufficiently to provide yolk for developing eggs.

DISCUSSION

Leiopisma orocryptum is most similar in morphology to three other species which occur in Tasmania, *L. metallicum*, *L. microlepidotum* and *L. pretiosum*. All four have fused frontoparietals, lack supranasals and postnasals, have a colour pattern consisting basically of a black-marked brown dorsum and black upper lateral stripes, and show overlap in midbody scale-row count. Intraspecific variation in scalation and coloration can mean that individuals of one species can resemble one of the others very closely in particular features, although taking several features together normally enables unambiguous identification (Table 1).

The greatest amount of overlap is between some *L. orocryptum* and southern (allopatric) *L. microlepidotum* (Mt Hartz/Mt La Perouse area; see Hutchinson *et al.* in press). Southern *L. microlepidotum* have unusually variable paravertebral counts, and low counts (less than 68) are relatively common. These animals also may have only 30 midbody scales (although this count is rare) so that both parameters may be within the normal range of *L. orocryptum*.

In addition, these southern *L. microlepidotum* include a colour-pattern variant not seen elsewhere in the range of the species in which black paravertebral stripes are present, as in many *L. orocryptum*, and a white mid-lateral stripe may also be distinct. Should all of these be present on a single individual, as is the case in TM C355 from the Mt La Perouse area, there is nevertheless a general impression of robustness and shortness of limbs which identifies the specimen as *L. microlepidotum*. However this ambiguity is admittedly a problem in these southern areas and further work is needed to clarify the limits of variation within these two species.

It is also of interest to note that while *L. metallicum* includes specimens which may resemble *L. orocryptum* in scale counts and colour pattern, the populations from southwest Tasmania which are sympatric or parapatric with *L. orocryptum* do not include such individuals. In these populations all animals appear to be consistently very strongly striped with no speckling breaking up the dark dorsal or white lateral lines, and the scales are usually strongly keeled, often with angular free margins.

L. orocryptum with a weakly-developed dorsal pattern can strongly resemble similarly lightly-patterned *L. pretiosum*. The latter species however is markedly smaller and there is little overlap in midbody scale row counts. The two species have not yet been recorded in sympatry, and relatively few specimens of *L. orocryptum* are known, so that future efforts to find sympatric or closely-parapatric populations of *L. orocryptum* and *L. pretiosum* are essential to establish the presence or absence of any intergradation.

Rawlinson (1974b, 1975) and Greer (1982) have identified two subgroups within the southern Australian *Leiolopisma*, the litter-dwelling, large-scaled *baudini* group and the scansorial small-scaled *spenceri* group. There is actually considerable overlap in most of the characters used to define these groups (see Greer 1982, table 8), the only clear differences being a consistently small litter size (1-4) and a flattened, long-legged habitus in the *spenceri* group, versus clutch or litter size (1-12) positively correlated with female size in the *baudini* group, in which the species have a more short-limbed, non-depressed habitus. Within the Australian *Eugongylus* group (Greer 1979), the body shape and restricted litter size of the *spenceri* group are probably both derived, so that the *baudini* group species are united by primitive character states, implying that they, at least, may not be monophyletic.

Hutchinson *et al.* (ms.) questioned the phylogenetic reliability of the two species groups, but suggested that at least most of the *spenceri* group species (all except *L. spenceri* itself) were probably monophyletic and termed these the Tasmanian subgroup, because all were restricted to Tasmania or its adjacent islands. *L. orocryptum* is clearly a member of this Tasmanian subgroup that therefore now includes *L. greeni*, *L. microlepidotum*, *L. ocellatum*, *L. orocryptum*, *L. palfreymani* and *L. pretiosum*.

Compared with *L. spenceri*, the Tasmanian species are derived in having fused frontoparietals, but *L. spenceri* has a derived, large, palpebral disc (diameter 0.6 times the eye diameter) and the variable development of beta-like projections (Greer & Parker 1968) on the pterygoids (MNH, pers. obs.), both features being uniquely shared with *L. entrecasteauxii*, a *baudini* group species. It is thus possible that *L. spenceri* represents an independent scansorial lineage and that its sister taxon is *L. entrecasteauxii* rather than the Tasmanian subgroup. In their turn, the species of the Tasmanian subgroup may share a sister group relationship with one or more *baudini* group species. *L. metallicum* with its fused frontoparietals, small palpebral disc, viviparity, overlapping range of colour patterns and Tasmanian centre of diversity is the most likely such sister taxon.

The link between *L. metallicum* and the Tasmanian subgroup species is strengthened by the presence in *L. metallicum*, *L. pretiosum* and *L. ocellatum* of a unique type of chorioallantoic placenta (Type II of Weekes 1935, Yaron 1985). *L. spenceri* probably shares a different placental structure (Type III, Weekes 1935) with *L. entrecasteauxii*, which may also strengthen the argument for these two species to be grouped together. The second case is less strong however, since the Type III placenta has evolved more than once (also in *Chalcides chalcides*) and there is some doubt concerning the identity of all of Weekes' specimens of *L. spenceri*, at least some of which were probably *L. coventryi* (Rawlinson 1974b).

A recent hypothesis for another method of subdividing Australian *Leiolopisma* is that proposed by Greer (in press, pers. comm.), which suggests that *L. spenceri* and *L. palfreymani* (i.e. *Pseudemoia*), plus the *L. entrecasteauxii* complex, *L. zia*, *L. jigurru* and *L. coventryi*, can be separated from the rest based on the fusion of the atlantal neural arch to the centrum.

These hypotheses are all based on a small number of derived character states, and parallel evolution is likely to be a problem here, as it is with virtually all scincid phylogenetic characters. Biochemical studies currently being carried out by Baverstock and co-workers and by two of us (MNH and TDS) should help to choose among these hypotheses and determine the patterns of morphological change within this group of species.

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